UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/668,869	09/22/2003	Richard D. Breault	C-2789	3166

7590 07/17/2006

M. P. Williams
210 Main Street
Manchester, CT 06040

EXAMINER	
LEWIS, BEN	

ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 07/17/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No. 10/668,869	Applicant(s) BREAULT ET AL.	
	Examiner Ben Lewis	Art Unit 1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on ____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) *19 and 21* is/are withdrawn from consideration.

5)☐ Claim(s) ____ is/are allowed.

6)☒ Claim(s) *1-18 and 20* is/are rejected.

7)☐ Claim(s) ____ is/are objected to.

8)☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 September 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *9/22/03*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. ____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: ____.

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

   I. Claims 1-18 and 20, drawn to a fuel cell stack for a fuel cell power plant, classified in class 429, subclass 39.

   II. Claims 19, 21, drawn to a method of operating a fuel cell stack, classified in class 429, subclass 13.

2. Inventions I and II are related as process and apparatus for its practice. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP § 806.05(e)). In this case as admitted in the subject matter of the present claims the fuel cell stack of claims 1-18 can be operated used by three distinct operating methods as recited n claims 19, 20 and 21 respectively.

3. If invention II is elected, an election of species is required. This application contains claims directed to the following patentably distinct species of the claimed invention.

II-1, Claim 19, drawn to method of operating a fuel cell stack without external water management apparatus comprising:

a) Expelling 80% - 95% of product water generated at the cathodes of the fuel cells of each stack as vapor in the exhaust of said oxidant reactant as flow fields.

b) Transferring, by means of at least one water transfer path within said stack between 25%-40% of product water generated at the cathode of said fuel cells from said cathode water transport plates of said fuel cells to said anode water transport plates of said fuel cells; and

c) Removing between 5% and 15% of product water generated at the cathodes of said fuel cells to exhaust from said anode water transport plates.

II-2 Claim 21, drawn to a method of operating a fuel cell power plant having a stack of fuel cells, each fuel cell including a membrane electrode assembly having a proton exchange membrane between a cathode catalyst and an anode catalyst, an anode support plate adjacent said cathode catalyst, a cathode support plate adjacent said cathode catalyst, a porous anode water transport plate having fuel reactant gas flow field adjacent said anode transport plate, and a cathode water transport plate having an oxidant reactant gas flow field adjacent to said cathode support plate, the anode water transport plates of each cell having water flow channels, a plurality of solid cooler plates separating said fuel cells into groups of between 2 and 6 fuel cells per group, each of said cathode

water transport plates adjacent to one of said solid cooler plates also having water flow channels, said method comprising

a) conducting water only internally within said fuel cell stack from a cathode water transport plate at a first end of said fuel cell stack to an anode water transport plate at a second end of said fuel cell stack opposite said first end through at least one internal water manifold in liquid communication with all of said water transport plates.

During a telephone conversation with Mr. M. P. Williams. On June 28th, 2006, a provisional election was made with traverse to prosecute the invention of Invention I species I, claims 1-18 and 20. Affirmation of this election must be made by applicant in replying to this office action. Claims 19 and 21 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 18 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described

in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. It is not clear as to how the percentages of water expelled and recirculated by the system can be greater than 100%.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1-9, 12-18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koch et al (U.S. Pub No. 2003/014816A1) and further in view of Cisar et al. (U.S. Pub. No. 2003/0232234 A1).

With respect to claims 1 and 20, Koch et al disclose efficient fuel cell water transport plates wherein a fuel cell includes an anode, a cathode, and an electrolyte separating the two. Fuel reactant gas, typically a hydrogen rich stream, enters a support plate adjacent the anode (anode plate). Oxidant reactant gas, typically air, enters a support plate adjacent the cathode (cathode plate) (Paragraph 002). Due to their critical role in water management, the anode plates and cathode plates are often

called "water transport plates" (WTP's). During PEM fuel cell operation the WTP's supply water locally to maintain humidification of the PEM, remove product water formed at the cathode, and supply water to the fuel cell to replenish water that has been lost by evaporation. Furthermore, the water transport plates remove by-product heat via a circulating coolant water stream (coolant water); conduct electricity from cell to cell in stacks of cells of a fuel cell power plant; provide a gas separator between adjacent cells; and provide passages for conducting the reactants through the cells (Paragraph 0005).

Koch et al. also teach that, FIG. 2 is taken from U.S. Pat. No. 5,840,414, and provides background information indicating the importance of various properties of water transport plates. Briefly, the fuel cell stack as shown in FIG. 2 includes the polymer electrolyte membrane **20**, the porous cathode catalyst **22** and the porous anode catalyst **24** on the two sides of the membrane **20**. Hydrogen gas is supplied through the channels **26** of the upper separator plate **28**, and oxygen gas is supplied to the channels **30** of the lower separator plate **32**, with the channels **30** running perpendicular to the channels **26**. The hydrogen and oxygen combine, producing water and electricity. Coolant water flows through channel **36**. Additional membranes and separator plates are included in the stack, and the electrochemical reaction is taking place concurrently at various levels in the stack (Paragraph 0041).

Regarding the plates being porous and having water flow channels, Koch et al teach that typically, plates according to the present invention have a median pore size of 0.4 to 5.0 μm, with at least 50% pores by volume below 3.0 .μmM in size. Typically,

the plate is stiff and provided with continuous flow channels on one or both faces of the plate (Paragraph 0064).

Koch et al also teach that referring more particularly to the drawings, FIG. 1 is a schematic showing of a fuel cell system. The system of FIG. 1 includes a source of hydrogen gas **12**, a source of oxygen **14**, which could be atmospheric air, and a fuel cell stack **16** which includes polymer electrolyte membranes (PEM) and separators, or water transport plates, as discussed below. The hydrogen and oxygen are combined, producing water as indicated by reference number **18**, and electricity as indicated at reference numeral 20 (Paragraph 0040).

Koch et al. does not specifically teach water transfer means disposed in each of said fuel cells for transferring watery only internally within said stack from said cathode water transport plate to said anode transport plates. However, Cisar et al. disclose an electrochemical cell and bipolar assembly for an electrochemical cell wherein, the bipolar assembly of the present invention comprises a gas barrier and an array of electronically conducting and protruding posts engaged with the gas barrier (Paragraph 0041). Optionally, the gas barrier may provide the ability to transfer water between the cathode of one cell and the anode of an adjacent cell while maintaining isolation of the anode and cathode gases. The gas barrier that transfers water can be made from a water permeable material or a composite that includes a water permeable material. Suitable water permeable materials include, but are not limited to, silica, hydrophilic polymers, and cellulose (Paragraph 0045). Therefore it would have been obvious to one of ordinary skill in the art to incorporate the water transfer means of Cisar et al. in to

the fuel cell of Koch et al because Cisar et al teach that accordingly, water produced at the cathode, and normally rejected in the exhaust, passes through the barrier where it humidifies the fuel being consumed. This is advantageous because it promotes the full humidification of the PEM membrane, which minimizes its resistance to proton flow (Paragraph 0016).

With respect to claim 2-8, Koch et al. teach that, FIG. 2 is taken from U.S. Pat. No. 5,840,414, and provides background information indicating the importance of various properties of water transport plates. Briefly, the fuel cell stack as shown in FIG. 2 includes the polymer electrolyte membrane **20**, the porous cathode catalyst **22** and the porous anode catalyst **24** on the two sides of the embrane **20**. Hydrogen gas is supplied through the channels **26** of the upper separator plate **28**, and oxygen gas is supplied to the channels **30** of the lower separator plate **32**, with the channels **30** running perpendicular to the channels **26**. The hydrogen and oxygen combine, producing water and electricity. Coolant water flows through channel **36** "manifold". Additional membranes and separator plates are included in the stack, and the electrochemical reaction is taking place concurrently at various levels in the stack (Paragraph 0041).

With respect to claim 9, Koch et al teach that referring more particularly to the drawings, FIG. 1 is a schematic showing of a fuel cell system. The system of FIG. 1 includes a source of hydrogen gas **12**, a source of oxygen **14**, which could be

atmospheric air, and a fuel cell stack **16** which includes polymer electrolyte membranes (PEM) and separators, or water transport plates, as discussed below (Paragraph 0040).

With respect to claim 12, Cisar et al. discloses an electrochemical cell and bipolar assembly for an electrochemical cell wherein, the bipolar assembly of the present invention comprises a gas barrier and an array of electronically conducting and protruding posts engaged with the gas barrier (Paragraph 0041). Optionally, the gas barrier may provide the ability to transfer water between the cathode of one cell and the anode of an adjacent cell while maintaining isolation of the anode and cathode gases. The gas barrier that transfers water can be made from a water permeable material or a composite that includes a water permeable material. Suitable water permeable materials include, but are not limited to, silica, hydrophilic polymers, and cellulose (Paragraph 0045). The material used to make the gas barrier may also include fillers that promote strength, electronic conductivity, water permeability, or combinations thereof. These properties of the gas barrier may be provided by a single material or a composite. Optionally, the composite may include particles (such as fibers, powders, or pellets) that provide one or more of these properties. Particles suitable for enhancing electronic conductivity include, without limitation, ceramics, metals, alloys, graphite, or combinations thereof. Particles suitable for enhancing strength include, without limitation, silicon carbide, graphite, metals, and ceramics. Particles suitable for enhancing water permeability were set out above. Still other particles may be included

to enhance other desirable properties of the composite, such as further reducing the weight, and making the composite hydrophobic or hydrophilic (Paragraph 0046).

With respect to claim 14 Cisar et al. teaches that in another embodiment, the gas barrier may be formed independently of the posts by casting the gas barrier around the array of posts. This may be accomplished, for example, by embedding the lower portion of the posts in a sacrificial material, creating a gas barrier layer on the top surface of the sacrificial material, curing or hardening the gas barrier layer, and, dissolving, or otherwise removing the sacrificial layer leaving the freestanding gas barrier secured to the posts (Paragraph 0014).

With respect to claim 15-16, Cisar et al. teach that optionally, the gas barrier may provide the ability to transfer water between the cathode of one cell and the anode of an adjacent cell while maintaining isolation of the anode and cathode gases. The gas barrier that transfers water can be made from a water permeable material or a composite that includes a water permeable material. Suitable water permeable materials include, but are not limited to, silica, hydrophilic polymers, and cellulose (Paragraph 0045). Cisar et al. also teach that the barrier may be solid, or porous, with the pores "holes" filled with a material that promotes the transfer of water from the cathode to the anode (Paragraph 0045).

With respect to claim 17, Cisar et al. teach that FIG. 1 is a cross sectional view of a bipolar assembly suitable for low-pressure operation in an electrochemical stack. The gas barrier 14, which may be electronically conducting or non-conducting, separates the reactant fluids flowing across the face of the anode electrode 11 and the cathode electrode 12. A plurality of posts 15 is disposed across the gas barrier 14, each post being approximately perpendicular to the gas barrier. One end of each post contacts the current collector 13 on the anode electrode 11 and the other end of each post contacts the current collector 13 on the cathode electrode 12. The posts and the gas barrier form the "post-type" flow fields for the reactant fluids. One embodiment, as illustrated in FIG. 1, shows the posts 15 inserted through holes in the gas barrier 14, each post being sealed 16 into the hole in the gas barrier through which the post passes, thereby preventing reactant fluids from passing from one side of the gas barrier to the other (Paragraph 0051).

7. Claims 10-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koch et al (U.S. Pub No. 2003/014816A1) and Cisar et al. (U.S. Pub. No. 2003/0232234 A1) as applied to claims 1-9, 12-18 and 20 above and further in view of Asano et al. (U.S. Pub. No. 2002/0164513 A1).

With respect to claims 10-11, Koch et al and Cisar et al. disclose a fuel cell system in paragraph 2 above. Koch et al and Cisar et al do not specifically teach wherein said membrane has a microporous water-filled phase in excess of 10% volume

or between 15% and 25%volume. However, Cisar et al. teaches that , water produced at the cathode, and normally rejected in the exhaust, passes through the barrier where it humidifies the fuel being consumed. This is advantageous because it promotes the full humidification of the PEM membrane, which minimizes its resistance to proton flow. A moisture transfer capability like this can be achieved by utilizing a single phase polymer capable of absorbing substantial amounts of water or by producing a porous barrier having pores filled with such a polymer or with another substance that promotes the transfer of water. Examples of polymers that absorb or conduct moisture include perfluorosulfonic acids (such as Nafion), sulfonated polystyrene, sulfonated trifluorostyrene, polyacrylamides, and similar polymers (Paragraph 0016). Therefore, since the membrane of Cisar et al. is capable of absorbing substantial amounts of water the membrane of Cisar et al. would be contain water well in excess of 25% volume.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ben Lewis whose telephone number is 571-272-6481. The examiner can normally be reached on 8:30am - 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Ben Lewis

PATRICK JOSEPH RYAN
SUPERVISORY PATENT EXAMINER

Patent Examiner
Art Unit 1745